79. A method of separating a target from a sample composition containing the target, comprising the following steps:

(a) contacting the sample composition with a reactive affinity molecule attached to a phase separating group, the reactive affinity molecule comprising a reactive functional group, and the reactive affinity molecule reacting with the target to form an adduct by forming a covalent bond between the target and the reactive functional group, where the reaction forming the adduct is reversible under the conditions of the contacting without the addition of a reagent acting at the covalent bond,

(b) separating the adduct from the sample composition;

(c) contacting the adduct with an eluent to regenerate the target and the reactive affinity molecule; and

(d) separating the target from the reactive affinity molecule.

80. The method of claim 79 where the reactive functional group comprises a group chosen from N=N, C=C, C=O, N=O, C=N, C=S, and C≡C.

81. The method of claim 79 where the target comprises a 1,3-diene and the reactive functional group comprises a nitroso group.

82. The method of claim 79 where the target comprises a hydroxy, mercapto, or amino group and the reactive functional group comprises an aldehyde group.

83. The method of claim 79 where the target comprises a hydroxy, mercapto, or amino group and the reactive functional group comprises an alkene substituted by an anion stabilizing group.

84. The method of claim 79 where the target comprises a hydroxy, mercapto, or amino group and the reactive functional group comprises a ketone.

85. The method of claim 79 where the target comprises a hydroxy, mercapto, or amino group and the reactive functional group comprises an iminium group.

86. The method of claim 79 where the target comprises a hydroxy, mercapto, or amino group and the reactive functional group comprises a carboxylate ester.

87. The method of claim 79 where th reactive affinity molecule is attached to the phase separating group by a covalent bond, chemisorption, or ion-pairing.

88. The method of claim 79 where the phase separating group is a solid.

89. The method of claim 88 where the solid is chosen from polymers, silica, alumina, and carbon.

90. The method of claim 89 where the solid is a polymer.

91. The method of claim 90 where the solid is a macroreticular polymer.

92. The method of claim 90 where the solid is chosen from polyethers, polyamides, polyesters, and polyenes.

93. The method of claim 90 where the solid is chosen from polyacrylates and polystyrene.

94. The method of claim 88 where the solid is a stationary phase of a chromatographic column.

95. The method of claim 79 where the phase separating group comprises a group that imparts to the adduct solubility in a liquid.

96. The method of claim 95 where the group that imparts solubility in a liquid is a water solubilizing group.

97. The method of claim 96 where the group that imparts solubility in a liquid is chosen from sulfate, sulfonate, phosphate, phosphonate, carboxylate, ammonium, phophonium, sulfonium, and guanidinium ions, polyhydric alcohols, and polyethers.

98. The method of claim 95 where the group that imparts solubility in a liquid imparts solubility in a water immiscible phase.

99. The method of claim 79 where the reactive affinity molecule further comprises a reactivity modifier group.

100. The method of claim 99 where the reactivity modifier group comprises an acidic group chosen from carboxylic acids, phenols, ammonium cations, phosphates, phosphate esters, phosphonates, and phosphonate esters.

101. The method of claim 99 where the reactivity modifier group comprises a basic group chosen from amines, heteroaryl amines, carboxylates, phenolates, phosphate anions, and phosphonate anions.

102. The method of claim 99 where the reactivity modifier group is chosen from halogens, nitro groups, cyano groups, hydroxyl groups, alkoxy groups, fluoroalkyl groups, perfluoroalkyl groups, nitrile groups, carboxyl groups, carboxylic ester groups, amide groups, sulfoxide groups, sulfone groups, carbonyl groups, and ammonium groups.

103. The method of claim 99 where the reactivity modifier group is chosen from hydroxyl groups, amine groups, monoalkylamine groups, dialkylamine groups, and alkoxy groups.

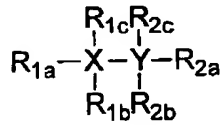
104. The method of claim 99 where the reactivity modifier group alters a property of the reactive functional group chosen from electronic characteristics, steric availability, and chirality.

105. The method of claim 99 where the eluent changes the equilibrium constant of the reaction by modifying the reactivity modifier group.

106. The method of claim 79 where the reactive affinity molecule further comprises a framework group.

107. The method of claim 106 where the framework group comprises a group chosen from alkyl groups, aryl groups, and heteroaryl groups.

108. The method of claim 79, where the reactive affinity molecule comprises a group of formula

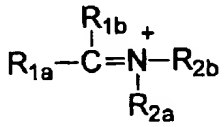


where R_{1a}, R_{1b}, R_{1c} R_{2a}, R_{2b} and R_{2c} are each independently absent or are chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, framework groups with reactivity modifier groups, a direct bond between X and Y, and a direct bond to a phase separating group; and

where X and Y are each independently chosen from C, O, N, and S, and each independently may have a positive or a negative charge.

109. The method of claim 108 where the reactive affinity molecule comprises a group chosen from $R_{1a}(R_{1b})C=C(R_{2a})R_{2b}$, $R_{1a}(R_{1b})C=O$, $R_{1a}(R_{1b})C=N\text{-}R_{2a}$, and $R_{1a}\text{-}N=O$.

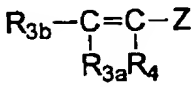
110. The method of claim 79 where the reactive affinity molecule comprises a group of formula



where R_{1a}, R_{1b}, R_{2a}, and R_{2b} are each independently chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, framework groups with reactivity modifier groups, and a direct bond to a phase separating group;

or where $R_{1a}(R_{1b})C=N^+(R_{2a})R_{2b}$ forms a ring structure.

111. The method of claim 79 where the reactive affinity molecule comprises a group of formula

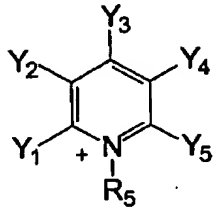


where R_{3a}, R_{3b} and R_4 are each independently chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, framework groups with reactivity modifier groups, and a direct bond to at least one phase separating group; and

where Z comprises an anion stabilizing group.

112. The method of claim 111 where Z comprises a group chosen from nitro, ketone, ester, amide, sulfoxide, sulfone, nitrile, iminium, and phosphonium groups.

113. The method of claim 79, where the reactive affinity molecule comprises a group of formula



where R_5 is chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, framework groups with reactivity modifier groups, and a direct bond to at least one phase separating group; and

where Y_1, Y_2, Y_3, Y_4, and Y_5 are each independently chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, framework groups with reactivity modifier groups, and a direct bond to at least one phase separating group.

114. The method of claim 79, where the reaction comprises the formation of at least two covalent bonds.

115. The method of claim 79 where the eluent is chosen from water, alcohols, hydrocarbons, and ethers.

116. The method of claim 115 where the eluent is chosen from methanol, ethanol, propanol, isopropanol and butanol.

117. The method of claim 115, where the eluent is chosen from benzene, toluene, xylenes, mesitylenes, hexanes, heptanes, octanes and nonanes.

118. The method of claim 115, where the eluent is chosen from propyl ethers and butyl ethers.

119. The method of claim 79, where the eluent has a property chosen from polarity, temperature, and pH that is different from the corresponding property of the sample composition.

120. The method of claim 119 where the eluent has a temperature that is different from the temperature of the sample composition.

121. The method of claim 79 where the half-life of the reaction is about 4 hours or less at 25^{0}C under the contacting conditions.

122. The method of claim 79 where the step of contacting the adduct with the eluent also separates the target from the reactive affinity molecule.

123. The method of claim 79 where the target is chosen from ergosterol, thebaine, and vitamin D.

124. A method of separating a target from a sample composition, comprising

adding a water immiscible solution comprising the sample composition to an aqueous solution comprising a reactive affinity molecule comprising a water solubilizing group and a reactive functional group, where the reactive affinity molecule reacts with the target to form a water-soluble adduct by forming a covalent bond between the target and the reactive functional group, where the reaction forming the adduct is reversible under the conditions of the addition without the addition of a reagent acting at the covalent bond;

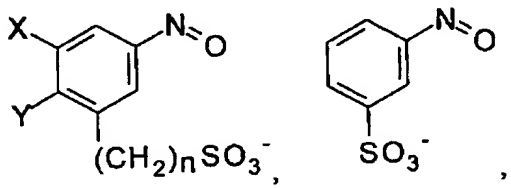
separating the water immiscible solution and the aqueous solution containing the water-soluble adduct;

extracting the target from the aqueous solution.

125. The method of claim 124 where the target is extracted from the aqueous solution by changing the equilibrium constant of the reaction.

126. The method of claim 125 where the equilibrium constant of the reaction is changed by exposing the water soluble adduct to a change in a property chosen from polarity, temperature, and pH.

127. The method of claim 124 where the reactive affinity molecule is chosen from



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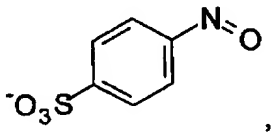

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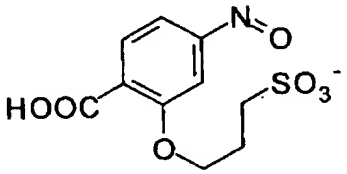
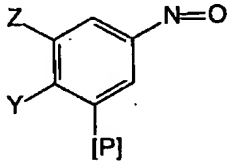


where X and Y are chosen from H, alkyl groups, aryl groups, heteroaryl groups, and reactivity modifying groups,

and the target comprises a 1,3-diene.

128. A method for isolating thebaine from a sample composition, comprising contacting the sample composition with a reactive affinity molecule of the formula:



where Y and Z are each independently chosen from H, alkyl groups, aryl groups, heteroaryl groups, framework groups, reactivity modifier groups, and framework groups with reactivity modifier groups; and

[P] is a phase separating group.

129. A chromatographic stationary phase comprising a reactive affinity molecule attached to a phase separating group, the reactive affinity molecule comprising a reactive functional group and the reactive affinity molecule reacting with a target to form an adduct by forming a covalent bond between the target and the reactive functional group, where the reaction forming the adduct is reversible under the conditions of the contacting without the addition of a reagent acting at the covalent bond.

130. The chromatographic stationary phase of claim 129 where the reactive affinity molecule further comprises a reactivity modifying group.

131. The chromatographic stationary phase of claim 129 where the reactive affinity molecule further comprises a framework group.

132. The chromatographic stationary phase of claim 129 where the reactive functional group comprises N=O.

133. The chromatographic stationary phase of claim 129 where the reactive functional group comprises a group chosen from C=O, C=NR, C=C and RO-C=O, where R is chosen from H, alkyl groups, aryl groups, and heteroaryl groups.

134. The chromatographic stationary phase of claim 129 where the phase separating group is a solid.

135. The chromatographic stationary phase of claim 134 where the solid is chosen from polymers, silica, alumina, and carbon.

136. The chromatographic stationary phase of claim 135 where the solid is a polymer.

137. The chromatographic stationary phase of claim 136 where the solid is a macroreticular polymer.

138. The chromatographic stationary phase of claim 135 where the solid is chosen from polyethers, polyamides, polyesters, and polyenes.

139. The chromatographic stationary phase of claim 138 where the solid is chosen from polyacrylates and polystyrene.